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Presidential Address

By J. G. HOLMES, A.R.C.S., B.Sc., F.Inst.P.(*Fellow*)

The Study of Natural Lighting

My first words must be to express my thanks to this Society for the high honour you are conferring on me. I greatly appreciate the confidence which you so kindly show in me and, though I feel quite humble in standing like a new boy at the bottom of the list of distinguished Presidents, I have a certain pride in being the first in this list, now of thirty names, who has enjoyed the experience of chairmanship of an I.E.S. Centre.

For this Address I shall take up the subject of Natural Lighting, which I discussed with the Birmingham Centre seven years ago, and which, like artificial lighting, calls for close collaboration between lighting engineers and architects.

(1) Introduction

Although the lighting industry is not large, it is very active and changes in the technique of artificial lighting are continually occurring as new light sources, new materials and new methods of appraisal become available. This Society has made a substantial contribution to progress in artificial lighting in many different ways, of which I may mention the discussions at our meetings, the publication of Transactions which are widely regarded to be of a high technical standard, the liaison between experts in sectional meetings before the war and in technical committees during the war and since, the issue and re-issue of the I.E.S. Code for the Lighting of Building Interiors, and our joint efforts with other organisations, such as the Council for Codes of Practice, the Department of Scientific and Industrial Research and the Medical Research Council. In all these activities, one is continually conscious of the colleagueship of the members of this Society quite independently of any sectional or economic interest. In the past, many of the papers and discussions dealt with those subjects in which the lighting industry was directly interested, such as gas or electric lamps, materials or fittings for artificial lighting, but recently we have become more concerned with the fundamentals of good lighting practice and of the whole process of seeing, such as field-of-view engineering, contrast and revealing power, and the physiology of vision.

Most of our seeing is done by daylight. Our eyes were evolved for use in daylight; they would have been quite different if man had evolved in a uniform illumination of 10 lm/sq. ft. We find that we like daylight and we like to be in the open air or able to see out of a window even if only to see the roofs and walls and windows of other buildings. Architects have to provide this amenity and we find that they pay much more attention to the proper design of windows than to the provision of artificial lighting fittings—Le Corbusier has said that in the story of architecture throughout the centuries the history of windows has been an unceasing struggle between the desire for light and the laws of gravity.

An architect has many things to consider when designing windows—the appearance of the building, the layout of the rooms, the view into each room from outside and the view out of each room from inside, the admission of sunlight and fresh air, the loss of heat, the cleaning and maintenance—and with all these he is asked to combine the requirement of good lighting inside the room. I believe that an illuminating engineer should be able to give sound advice on daylighting and that an architect should be able to consult him on this subject with just as much confidence as on artificial lighting.

Presented at a meeting of the Society held in London, October 9, 1951.

"Illuminating Engineering" means the technical investigation or control of the process of illumination and it is our job to investigate natural lighting and, so far as we can, to control it.

Windows are so important that they should be designed with just as much care as any artificial lighting fitting; we have a wealth of knowledge about artificial lighting —illumination distributions, maintenance factors, brightness distributions, the effects of decoration and so on—which ought to be applied to natural lighting. We must recognise, with appreciation, that architects are trained in the subject of natural lighting and many of them gain considerable experience in this subject. It is my hope that in this Society we can blend these two sources of knowledge about lighting, just as we all have still to learn the best way of blending natural and artificial lighting.

Those who have studied natural lighting can also contribute to the proper use of artificial lighting. For example, the daylighting of a room is expressed as a percentage ratio (daylight factor) and experience shows that this works very well, and that the percentage figures give a very fair indication of the visual effect. Artificial lighting, on the other hand, is expressed in terms of absolute illumination, although the recent work by Weston and others has emphasised that visual performance and comfort depend very largely on relative rather than absolute luminance, that is, on a logarithmic or proportional scale rather than a linear scale. We might learn something very useful if we investigate some scheme of logarithmic evaluation of illumination or luminance, as was suggested by W. D. Wright for low illumination levels during the war and has been used by astronomers for the brightness of stars. Again, good daylighting is designed to be partly directional and to be non-uniform, which is quite a different basis from our ideas about artificial lighting of a few years ago, although our more recent ideas accept the need for non-uniformity and for the proper production of shadows.

Natural daylight can vary so very widely that no single daylight condition can be regarded as ideal lighting. Stonehenge has been called the most perfect example of good fenestration, with almost 100 per cent. daylight factor and insolation, but the visual conditions on the Altar Stone are rarely entirely satisfactory; the illumination varies from the glare level to darkness, the position of the principal source of light varies from east to west and from 0 deg. to 70 deg. elevation, the ratio of direct to diffuse illumination varies from zero to 10 times or more, and the colour of the lighting varies far more widely than that of artificial incandescent sources. But it could surely be agreed that, if ideal lighting could be defined, it would include a proportion of fully diffused light (as from the sky) to soften the shadows, and a proportion of highly directional light (as from the sun) to give life and texture and contrast in the field of view. We sometimes find these conditions in exterior daylight, we strive to achieve them in artificial lighting but we rarely attain them in the daylighting of interiors.

The requirements for daylighting and artificial lighting are sometimes thought to be quite different and this is certainly true of some rooms which serve different purposes by day and by night. Most rooms, however, are used for specific tasks, as in offices and factories, and there is no fundamental reason why the provision for artificial lighting should be different in its effects from that for natural lighting—in fact, most lighting installations are used to supplement daylight in the morning or evening. The recent development of fluorescent lamps which blend extremely well with daylight has led to rapid progress in the combination of natural and artificial lighting, and in a few instances, such as Room 29 in the National Gallery, the ordinary observer does not notice any difference between the two, because a successful attempt has been made to reproduce the distribution of light, as well as the colour effects of daylight. The use of artificial daylight lamps in colour-matching units is an entirely different problem; we all know what careful and extended researches have

been, and are being, made into the problems of colour rendering and although no fully acceptable artificial daylight unit has yet been found some of the recent filament and fluorescent combinations give extraordinarily good results. Colorimetrists know fairly well what is required and are able to tell the lamp makers what their results should be, so that there is a fairly definite target for artificial daylight lamps. The position is quite different in respect of the requirements for the distribution of light. Neither the daylighting expert nor the installation designer knows exactly what is wanted, although the latter is probably able to get nearer to the best result, but both of them now have a common problem: what is the best way of mixing natural and artificial light?

The purpose of this address is to encourage the study of natural lighting in this Society for two principal reasons, to make our experience of light distribution available to the architect, and, secondly, to use the experience of daylighting experts for the improvement of artificial lighting. A year ago, Mr. Davies emphasised that lighting engineers should be "research minded," and I would add that we ought always to be ready to study kindred techniques so as to improve our own.

(2) The Development of Windows

In prehistoric buildings, the only entry for light, apart from the doorway, was the chimney aperture in the roof. It is likely that the first windows were lanterns, perhaps like the one in the roof of this lecture room [at the Royal Institution], from which have developed the clerestory, which is common in ecclesiastical architecture and in some modern buildings, and the monitor roof which is becoming much more widely used in large factories. The doorway developed into the half-door which would admit light and yet provide some protection against the weather, and this type of window still persists in the fanlight and the half-glazed door.

The name window comes from the Norwegian word "vindauga," meaning "wind-eye" or "wind-hole," and large buildings were provided with narrow openings in the walls, the size and proportions of the holes being determined by the need to exclude both the weather and hostile intruders. In the course of history, parchment, oiled linen, thin sheets of horn and eventually glass were used for protection against the weather and then larger windows were employed, particularly in buildings which did not need to be fortified.

In the great churches of the Middle Ages, the builders were able to carry the roof load on pillars and buttresses and so to leave large areas between the buttresses, which they learned to decorate with fine stone lattice-work and with richly coloured glass. Domestic buildings followed this lead and windows grew to occupy a considerable part of the wall area, as shown particularly in Tudor houses which have large expanses of window designed more for the admission of light than for ventilation or clear vision. The seventeenth century brought the regular pattern of well-proportioned rectangular windows with sliding wooden sashes which became progressively refined in the Georgian period, now regarded as one of the highest levels of achievement of window design. The window tax which was imposed at the end of the seventeenth century hindered the development of windows until it was repealed just over 100 years ago and, during that time, it was surely a far more vicious tax on light than any modern rate of purchase tax. Fortunately, it was based on the total number of windows in a house and it did not reduce the area of individual windows, and even 200 years ago it was fully realised that the window should be as high as possible to achieve the maximum penetration of daylight into a room without causing excessive glare. The bay window owed its popularity to a desire to see out of a house and was perhaps the first window primarily designed to be looked through and to give an extensive view from within a room.

It is surprising that Victorian architects showed so little imagination after the

repeal of the window tax and when larger and clearer panes of glass became available at the time of the Crystal Palace and the 1851 Exhibition. In this century, however, windows are changing their character and a search is being made for the proper relationship between the admission of sunlight and daylight and the needs of ventilation and clear vision. The thick glazing bars and heavy bay windows of the Victorians have given place to generously proportioned windows with large clear panes and freedom from unnecessary obstructions. There are still some architects who tend to regard the art of fenestration as being the proper arrangement of the pattern of window openings on the face of a building but the modern architect is able to build his windows so that the rooms are well lit, because he now has at his disposal a wide variety of building methods and structural components which help him to give more attention to the demand for more light in the continual struggle mentioned by Le Corbusier.

It is only within the last 40 years that the idea of the proper distribution of daylight has received much attention, and this has been due largely to the pioneer work of P. J. Waldram, an original member of this Society. His remarkable work on window calculations has been taken up by many others in all parts of the world and modern building practice is taking account of this development. But the distribution of daylight factor in a room is only one small item in the long list to be considered in assessing the daylighting of a room, and, although the mathematical methods described by Waldram and others are comprehensive, the full application of the figures which can be calculated has not yet been sufficiently studied. The process of designing windows is still in a state of development and many of the remaining problems relate to unmeasurable factors, such as the subjective visual and psychological effects, as well as to the ordinary problems of brightness distribution.

(3) The Properties of Windows

A window is not just a simple source of light. In some very special cases, such as that of an aircraft flying through cloud, a window may be indistinguishable from an illuminated panel, but usually a window gives a very complicated distribution of light; so complicated that it is rare to find two identical windows. Complicated lighting distributions are always interesting, and the Illuminating Engineer can immediately identify some of the more important variables such as, for example, the effects of the obstructions outside the window or the thickness of the wall in which it is mounted, and he can determine how these variables affect the seeing conditions inside the room, perhaps in terms of the distributions of flux and of luminance in different parts of the room.

I want to discuss two problems associated with the distribution of light and luminance, the use of diffusing glass and the use of louvres.

(3.1) Diffusing Glass

Diffusing glass is very widely used, either for privacy or for control of the light, and its effects have not been studied quantitatively to any great extent or, if so, the results have not been made generally available. Considering first the obscuring power of a patterned glass, it may be shown either mathematically or by experiment that there is a close correspondence between the effect of the glass in spreading a beam of light, as, for example, when it is placed in front of a floodlight to act as a diffuser, and the effect of the glass in obscuring objects which might be seen through it. If the polar curve of the diffused beam is known, the relative size and contrast of just-visible objects may be calculated, although the arithmetic is laborious. Conversely, a photometric experiment can be performed to put a "figure of merit" on either the diffusing power or the obscuring power of a pane of patterned glass. This is a problem in illuminating engineering rather than in optics or in vision, and its solution would be of value both

to the architect and to the designer of lighting fittings who wishes to prevent direct vision of the lamps in a fitting by the use of a patterned glass or plastic diffuser.

It is no less important to be able to predict the effect of a patterned glass on the distribution of light in a room, though this is much more difficult in general terms. If such a glass is used in a window, its effect is usually small in parts of the room where the daylight factor is high but a much larger effect may be observed in the badly lit parts of a room. Architects are familiar with the term " grumble point," which is given to the limit of adequate daylighting in a room, usually in an old building where the daylight factor is about 0.2 per cent., or slightly less. There is also the " no-sky point," at which the sky is not directly visible through a window, and here the daylight factor is usually of the order of 0.1 per cent. The use of a patterned glass may have a considerable effect on the illumination in this part of a room and may, in the right circumstances, greatly increase the daylight factor. When a window is badly obstructed by buildings outside, the light through clear glass enters very obliquely and goes straight down on to the floor so that it is very inefficiently used in daylighting the room. A lightly diffusing glass can spread this light usefully further into the room; a strongly diffusing glass can throw the light strongly towards the back of the room, with some risk of glare. In a particular case, I have known the illumination on a table at the back of a room to be nearly doubled by the use of light net curtains and increased more than 10 times by the use of suitable prismatic glass (0.05 per cent. to 0.6 per cent.). This is not a magnification of light but rather a redistribution, and it involves all the problems with which we are familiar in rooms with strongly directional lighting.

A window fully glazed by patterned glass is more liable to cause glare than one with a few panes of clear glass, for a rather interesting reason. When there is some clear glass, one is easily able to estimate whether it is a bright or a dull day and to accommodate oneself to the lighting conditions, but when the window is fully diffusing it acts like a directional source of light and we should all expect glare if we attempted to light a room by a large beam-projector mounted in one wall. The special prismatic glass which can effect such a remarkable increase in daylight illumination in the darker parts of a badly lit room usually decreases the flux entering the room but it increases the intensity (candle power) of the light from the window in a horizontal direction and it can lead to serious glare due to the greatly increased contrast between the window and the surrounding wall. Here, as in many other applications, improvements in light control should be accompanied by improvements in the decoration of a room, or the improved distribution of light may not be acceptable to the people working in the room. Further, a room with a fully diffusing window, or with a wall of glass blocks, is liable to seem poorly lit unless the illumination level is higher than that in adjacent rooms, and a daylight factor of 1 per cent. or 2 per cent. under such circumstances seems less than the same daylight factor in a room with clear windows. Why is this ?—is it because the observer has no view of the sky to act as a reference, or is it because the more uniform distribution of light requires a higher average illumination to achieve the same sensation of brightness ?—whatever the reason there is work for an illuminating engineer in investigating the problem.

Modern building methods are giving us larger windows and bigger rooms in offices and factories, and patterned or diffusing glass of various kinds is being used increasingly for reasons of privacy and, sometimes, for cheapness. Generally, good daylighting is achieved, but I suggest this problem is worthy of attention and investigation for two reasons, firstly, to add to our knowledge of daylight distribution in rooms with large glazed areas and to pass this knowledge on to the architect, and, secondly, to learn from these studies anything which may be of value in designing artificial lighting. This is not only a laboratory investigation but it may be tackled on the full scale because there are in existing rooms a wide variety of daylighting conditions available for anyone who wants to investigate them seriously. Over 40

years ago P. J. Waldram suggested that one of the simplest methods of experimentation was to measure the working rate of people in different parts of a side-lit room, because such conditions gave constant diversity factors, and this method of experiment has been used in several investigations by the D.S.I.R. and it is still available to-day.

(3.2) Louvres

Secondly, I want to discuss the use of louvres, because we can learn a very great deal from the unconscious or deliberate use of cut-off methods in the daylighting of interiors. The walls and ceiling of any room act as louvres, to obscure the principal source of daylight, and architects have always employed the thickness of the wall, or the buildings or trees outside, to reduce the direct glare from windows. In medieval buildings, the buttresses and pillars restricted the direct light from each window to a relatively narrow angle and the builders found the results to be good; nowadays our thin walls and large areas of window sometimes call for screens or blinds to reduce the angle of strong direct lighting. Illuminating engineers have recently become more familiar with louvres because they are commonly used with tubular fluorescent lamps, with reflector-bulb lamps and other high luminance sources, but such louvres are often used only to absorb light in unwanted directions. In the design of buildings for daylighting, however, the louvre methods have generally been based more on the diffusion of light and the reduction of contrast, a lesson which we are only just learning in artificial lighting.

There may be several reasons for using louvres; to reduce the transmission of radiant heat from the sun or the high illumination given by direct sunlight, to reduce the luminance of the light from the sky, or to make the window more directional in its distribution of light, giving full illumination in some directions and making the window less conspicuous from other directions. Protection against radiant heat usually involves external blinds and is not a problem of controlling illumination. Reduction of direct sunlight may be by internal screens, of which the venetian blind is probably the best, but curtains (which are vertical louvres) or a roller blind (which is a single horizontal louvre) are also effective. All these generally act as reflectors or absorbers, to reduce the amount of flux entering the room or to restrict it to one part of the room, and they call for little comment except to note that a translucent blind can be a most distressing source of glare when direct sunlight falls on the window and, conversely, that light curtains can materially reduce glare by providing some degree of brightness-grading. The modern developments of translucent external louvres, of white or light-coloured venetian blinds and of light curtains emphasise the value of diffusing rather than absorbing louvres but they may cause glare if too much flux is transmitted into the room, in the same way as a diffusing glass window. Perhaps the most interesting type of louvre is that which makes the windows less conspicuous because this technique may also be applied to artificial lighting, and, in such case, the distributions of natural and artificial illumination may be the same. Many of us are familiar with the louvres designed recently by the Building Research Station for the National Gallery and for the Birmingham Art Gallery; these are recent examples of a well-established technique employed in museums and art galleries where the distribution of daylight illumination is a major factor in the appreciation of the contents of the room and where the architect was not unduly restricted by limitation of expense. The same principle is taken a stage further in some single-story buildings with deeply recessed clerestory lights or with deep tubular top lights which give excellent daylighting without sky glare, and in Basil Spence's design for Coventry Cathedral which employs strongly directional daylighting. These are examples of daylight engineering in which the modern architect is experienced and well-informed but about which the average illuminating engineer seems to know relatively little. We shall doubtless hear more of louvre techniques and screening of

lighting fittings when there has been greater development of the modern tendency to build the lighting fittings into the structure, just as windows and roof lights are built in.

In many modern buildings, the work requires artificial light throughout the working day and it is becoming more generally realised that the lighting installation needs the same careful design as is given to the fenestration of those buildings which are used in daylight only. In order to achieve the highest standard, lighting engineers must be expert in both sides of the art and, as I have indicated, there is a lot to be learned by study of the diffusion of light and the directional control of light from windows. It may be that lighting practice will develop in such a way that windows and fittings are designed to give the same effect, the spread of light from the windows being more closely controlled and the lighting fittings becoming more like artificial windows, so that these two sources of light may be blended without any disturbing effects, or it may be that windows will be used only for vision of the world outside and that they will be strongly supplemented by artificial light—in either event, we should be ready to advise and even to guide the development of design.

(4) Daylight Research

Much of the present research in this country and overseas relates to insolation, that is to the admission of direct sunlight and sun's heat, which cannot be regarded as part of illuminating engineering. The problems of arithmetic in calculating the admission of direct sunlight have mostly been worked out; the probability of getting direct sunlight at any particular moment is a problem for the meteorologist and statistician; the quantitative effects of heat gain and heat loss through windows are being closely studied, but these require the use of mathematics, weather records and physical measurements which combine to make the problem very difficult.

In this country there was considerable research activity before and during the war. Nearly half the Illumination Research Technical Papers published by the D.S.I.R. since 1925 have been on daylight; the work of P. J. Waldram has already been acknowledged and I may mention Allen, Beckett, Burnett, Dufton, McDermott, Smith, Stillman and Swarbrick who have contributed excellent papers to this Society and elsewhere; much of this work has been summarised in the D.S.I.R. Report on "The Lighting of Buildings" which was published in 1944 and which has been followed by Chapter 1 A—"Daylight" in the Codes of Practice for Building prepared by the Ministry of Works. During the war this Society published a Reconstruction Pamphlet on Natural Lighting and some general guidance is given in our I.E.S. Code for the Lighting of Building Interiors. In the six years since the war, the work at the Building Research Station has included mathematical and experimental work on daylight distribution by Allen and Bickerdike, the well-known experiments on glare by Hopkinson and Petherbridge, and the work on daylight illumination levels by McDermott; other work on daylight distribution and on the planning of building sites has been published by Stillman and Swarbrick, but apart from these individual workers there is not at present any great research activity in the utilisation of daylight.

In other countries, the story is quite different, and the interest in daylighting is growing rapidly. The Commonwealth Experimental Building Station in Australia has produced a quantity of original work on all aspects of daylighting; in France, methods of calculation are being examined in addition to experimental work on insolation; in Sweden, the work of Pleijel is important, particularly his techniques of using models to measure the distribution of illumination and the effects of inter-reflection at wall surfaces; in the United States there are several special daylighting laboratories and a quantity of most interesting work is in progress, particularly in connection with schools,

and the American Illuminating Engineering Society has published a comprehensive "Recommended Practice of Daylighting."

At the recent meeting of the Commission Internationale de l'Eclairage in Stockholm, the discussions on "Natural Daylight" were most interesting and were well attended. The reports presented to the meeting contained plenty of new material and a full programme of research was prepared for attention during the next four years—it is interesting that consideration is being given to an earlier meeting, in two years, because progress is so rapid.

It is perhaps to be expected that the greater part of the research into daylight should be undertaken by national organisations, such as the D.S.I.R. in this country, and that industrial organisations should concern themselves more with research into their own products. We must acknowledge with gratitude the work being done in the scientific civil service and also by some individual architects, but we must consider whether our industrial illumination laboratories and also our industrial organisations concerned with making the materials used in windows ought to take a greater share in this research.

(5) Conclusion

If, in this Society, we intend to encourage closer collaboration between the practising architect and the practising illuminating engineer on problems of natural and artificial lighting, we must learn the architect's approach to these problems and we must prepare ourselves to answer his questions on technical matters. We should therefore give added emphasis to the study of natural lighting in the training of an illuminating engineer, so that he can calculate sky factors as readily as utilisation coefficients or estimate daylight factors as readily as illumination levels. This can only be done by the deliberate action of those individual members who are responsible for guiding the training of entrants into the lighting industry, although some help may be given by the Society's Education Committee. The techniques of daylighting are valuable teaching material because they put great emphasis on where the light comes from and on its directional quality—daylighting also provides good material for examination questions. Much of the instruction and training in natural lighting must necessarily come from the study of books and technical journals, but it is easy to arrange one or two practical experiments which illustrate these studies, such as the effect of the height of a window on the measured daylight factor or the change in the relative distribution of illumination from natural to artificial light. We should not expect to achieve this immediately, but we can decide now on our policy and then hope that the next generation of lighting engineers will be well informed on natural lighting and will be able to make some new contribution to lighting practice.

A higher level of education in natural lighting can only be maintained if there is continual research into the same subject, and I would again urge that this be undertaken by industrial organisations as well as by the Department of Scientific and Industrial Research, which has sponsored most of the British contribution up to the present day. Perhaps this work should be tackled by the larger firms in the building industry, by window frame makers or glass makers, and if so I would urge them to join this Society and share their experience with us, but the majority of the applied research into illumination practice must be done in the laboratories of the lighting industry. Great benefit would result if these laboratories could include some items relating to natural illumination in parallel with their work on artificial illumination. The great merits of fluorescent lighting may seem to make the quality of natural lighting less important, but it is surely more true to say that the better we make our artificial daylight, the more we need to know about natural daylight. Fluorescent lamps have already given us acceptable artificial roof-lights and we may learn in time how to use them to give

acceptable artificial windows and how to harmonise the techniques of artificial and natural lighting.

"Window Engineering" has justified itself in specialised buildings, but its full realisation may be regarded as too expensive for general use. The expense of doubling the height of factory windows is often too great, even though the natural lighting may be more than doubled, but those of us who have made it possible to build windowless factories and troglodyte offices owe it to the working public to do something constructive about making the best possible use of the natural lighting which is available. As individuals, some of us have enabled the common man to spend many hours in a kind of light to which his eyes are as yet unaccustomed or unsuited; we have inflicted non-uniform spectral distributions on him; we have provided conditions of extreme glare as a commonplace; we try to alleviate his lot and to make his visual task easier but often we only give him more and more artificial light in which he becomes more efficient and more automatic—surely we owe it to him to devote some of our resources of knowledge and experience to the proper use of natural light.

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The following applicants have been duly elected by the Council to membership in the Society, and their names have been added to the list of members:—

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Opening Sessional Meeting in London

The opening meeting of the 1951-52 session took place at the Royal Institution, Albemarle-street, London, W.1, on Tuesday, October 9. The chair at the opening of the meeting was taken by the retiring president, Mr. L. J. Davies, who, after the preliminary announcements, called upon the new President, Mr. J. G. Holmes, to deliver his Presidential address, entitled " The Study of Natural Lighting."

In his address Mr. Holmes urged lighting engineers to give more attention to the study of daylight and said that lighting engineers should be able to advise architects on this subject with as much confidence as they do on artificial lighting. There was much in common between natural lighting and artificial lighting in the case of interiors used for specific purposes such as offices and factories where artificial lighting is already frequently used to supplement natural lighting. There were, however, certain problems which needed the attention of the illuminating engineer, one of them being the best way in which daylight and artificial light could be mixed. There were also problems in connection with window design and window materials such as the use of diffusing glass to improve the daylight factor within the room. Mr. Holmes pointed out that apart from a few individual workers little research is being done in this country on natural lighting, and he suggested that in addition to official bodies such as the D.S.I.R. industrial research organisations in the lighting and glass industries might also profitably study the subject.

A vote of thanks to Mr. Holmes was proposed by Mr. J. M. Waldram, who said he was particularly pleased to do so not only because of his long association with Mr. Holmes but also because of the subject of the address. He fully agreed with the views expressed by Mr. Holmes, and said that lighting engineers would be much better equipped to carry out their jobs if they had a better knowledge of daylighting. It was usually assumed that daylighting was a specialist's subject whereas the problems of lighting an interior by natural or artificial light were fundamentally the same, and, as Mr. Holmes had said, lighting engineers should be able to advise on both methods. The study of natural lighting was of particular importance at present on account of the tendency to abandon former ideas of levels of illumination on the so-called working plane and when the subject of brightness was being given some prominence. Mr. Waldram pointed out that there was only a limited amount of daylight available and that it was of the greatest importance in building and town planning to see that the available daylight is used to the best advantage.

In seconding the vote of thanks Mr. C. R. Bicknell said that Mr. Holmes had shown that he had a comprehensive knowledge of natural lighting and all who heard or read his address would, he felt sure, feel an urge to know far more about natural lighting. Mr. Bicknell said that he thought the subject was one which ought to be discussed more fully at an ordinary sessional meeting of the Society. He congratulated Mr. Holmes on the subject of his address and his delivery.

After the vote of thanks Mr. Davies, before handing over to Mr. Holmes, expressed his thanks to the officers of the Society, to members of Council and to the members for their help to him and their reception of him as President both in London and in the Centres and Groups. Introducing Mr. Holmes, he said he was as a scientist closely associated with the lighting industry; he had presented a number of papers and had been awarded the Leon Gaster Memorial Premium. Mr. Holmes had also served on Council for a number of years and had worked very hard as Hon. Treasurer for the maximum period of three years.

Mr. Davies said he had every confidence in Mr. Holmes's leadership of the Society during the coming year.

Mr. Holmes in taking the chair expressed his appreciation of the confidence which had been expressed in him. He thanked Mr. Davies for the time and attention he had given to I.E.S. matters during the past year, which had been a particularly busy one for him, including in addition to his I.E.S. duties the Faraday lectures of the I.E.E. and a visit to America.

Mr. Holmes also welcomed the Vice-Presidents for the coming session, Dr. W. J. Wellwood Ferguson, Mr. A. G. Higgins, Mr. E. C. Lennox, Mr. L. C. Rettig and Dr. W. S. Stiles.

The President then announced that the Council had decided that the award of the Leon Gaster Memorial Premium for the past year should be made to Mr. H. W. Cumming for his paper entitled "The Extension of the Gas Arc Condition" and the award and certificate were presented to Mr. Cumming. The President announced that there had been no entries for the Silver Jubilee Commemoration Award and he asked members of the Society to draw the attention of the younger members to this award and to promote interest in the award.

The meeting then closed.

Corrigendum

BRIGHTNESS PATTERNS AND VISUAL FIELDS

By S. D. LAY

In Fig. 2 of the above paper, which was published in issue No. 7 of the Transactions this year, certain figures were omitted from the diagram. The diagram showed curves of equal contrast sensitivity. These curves, working from the centre of the diagram outwards, should have been marked as follows:—1.0, .95, .90, .86, .81, .76, .71, .67, .62, .57.

It would be appreciated if readers would kindly amend the diagram which appears on p. 174 of issue No. 7, 1951, accordingly.

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